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DEVELOPMENTAL MORPHOLOGY OF TROPICAL SORGHUM AND SORGHUM X SUDANGRASS

R. B. Mitchell, K. J. Moore, J. F. Pedersen, T. A. Peterson, L. E. Moser, and D. D. Redfearn[1]

Municipal wastes generated by sewage treatment facilities contain high concentrations of nitrogen (N) and other potential groundwater pollutants. A common waste disposal method is application to fallow cropland. A major concern associated with land application of organic wastes is the potential for excessive N loading which can result in groundwater contamination. Management strategies for converting N from organic wastes to useable agricultural products is crucial for minimizing groundwater pollution. Tropical sorghum and sorghum x sudangrass have been identified as species with high dry matter yield and high N scavenging potential and therefore should have high potential for use in a forage-based N remediation program. The purpose of this study was to quantify the developmental morphology

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Abstract

Tropical sorghum and sorghum x sudangrass are known to be efficient scavengers of soil nitrogen and are important forage crops in the U.S. Nitrate contamination of groundwater due to disposal of organic wastes and excessive fertilization is a major concern in the Central Great Plains. A common disposal method of municipal wastes is application to fallow cropland. Quantification of the developmental morphology of tropical sorghum and sorghum x sudangrass is important to developing management strategies that allow multiple applications of organic wastes to optimize nitrogen removal and dry matter production. The objective of this study was to quantify the developmental morphology of tropical sorghum and sorghum x sudangrass irrigated at levels approximating transpiration and evaporative demand. Tropical sorghum mean stage by count (MSC) was 33% lower than MSC for sorghum x sudangrass in September. Leaf-to-stem ratio was greater for tropical sorghum than sorghum x sudangrass throughout most of the growing season. Dry matter per plant was as much as 30% greater for sorghum x sudangrass, although values were nearly equal at the end of the growing season.

Introduction

Municipal wastes generated by sewage treatment facilities contain high concentrations of nitrogen (N) and other potential groundwater pollutants. A common waste disposal method is application to fallow cropland. A major concern associated with land application of organic wastes is the potential for excessive N loading which can result in groundwater contamination. Management strategies for converting N from organic wastes to useable agricultural products is crucial for minimizing groundwater pollution. Tropical sorghum [*Sorghum bicolor* (L.) Moench.] and sorghum x sudangrass [*S. bicolor* (L.) Moench. x *S. bicolor* (L.) Moench.] have been identified as species with high dry matter yield and high N scavenging potential (Pedersen et al. 1991; Long, 1981; Myers, 1980) and provide the greatest potential for a forage-based N remediation program. Understanding the morphological development of tropical sorghum and sorghum x sudangrass hybrids will provide information for determining application and harvest schemes that optimize N uptake and forage production.

The purpose of this research is to develop systems that optimize N removal from land treated with organic wastes, and develop systems which allow multiple harvests of tropical sorghum and sorghum x sudangrass. This would allow multiple

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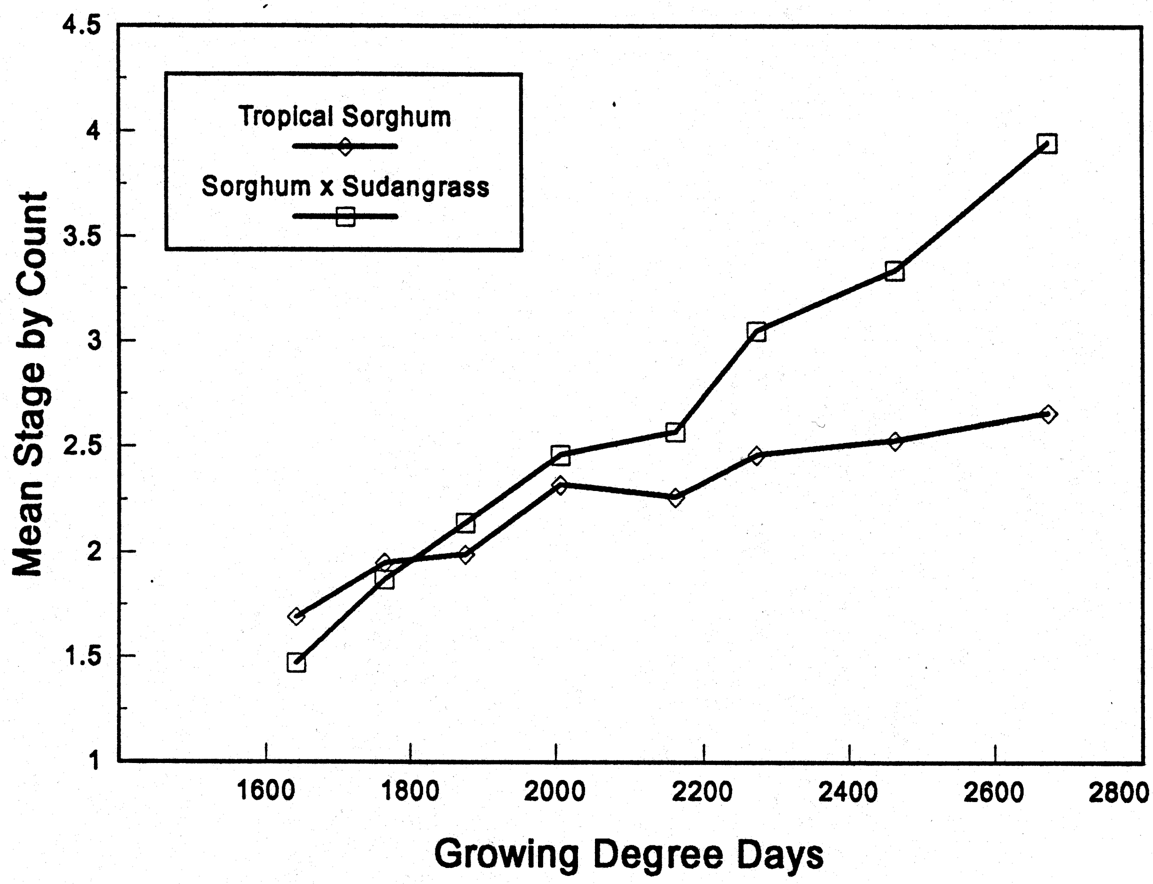

Fig. 1. Influence of growing degree days on mean stage by count (MSC).

applications of organic wastes during the summer months when land for waste application is often unavailable. The objective of this study was to quantify the developmental morphology of tropical sorghum and sorghum x sudangrass irrigated at levels approximating transpiration and evaporative demand grown in soils in which N is not limiting to crop growth.

Materials and Methods

This study was conducted in 1992 at the MSEA field research center near Shelton, NE as part of a five year study. Commercially available hybrids of tropical sorghum and sorghum x sudangrass were planted in 36 inch rows on 28 May. Following emergence, plants were hand-thinned to approximately 6 inch plant spacings. The experimental design was a randomized complete block with 3 replications. Eight harvest plots of two adjacent rows by 5 feet in length were randomly designated as harvest dates 1 through 8. The two harvest rows of each species were bordered on each side by one row of like species to minimize interactions due to plant height differences. Irrigation was applied at regular intervals to relieve moisture stress and approximate transpiration and evaporative demand.

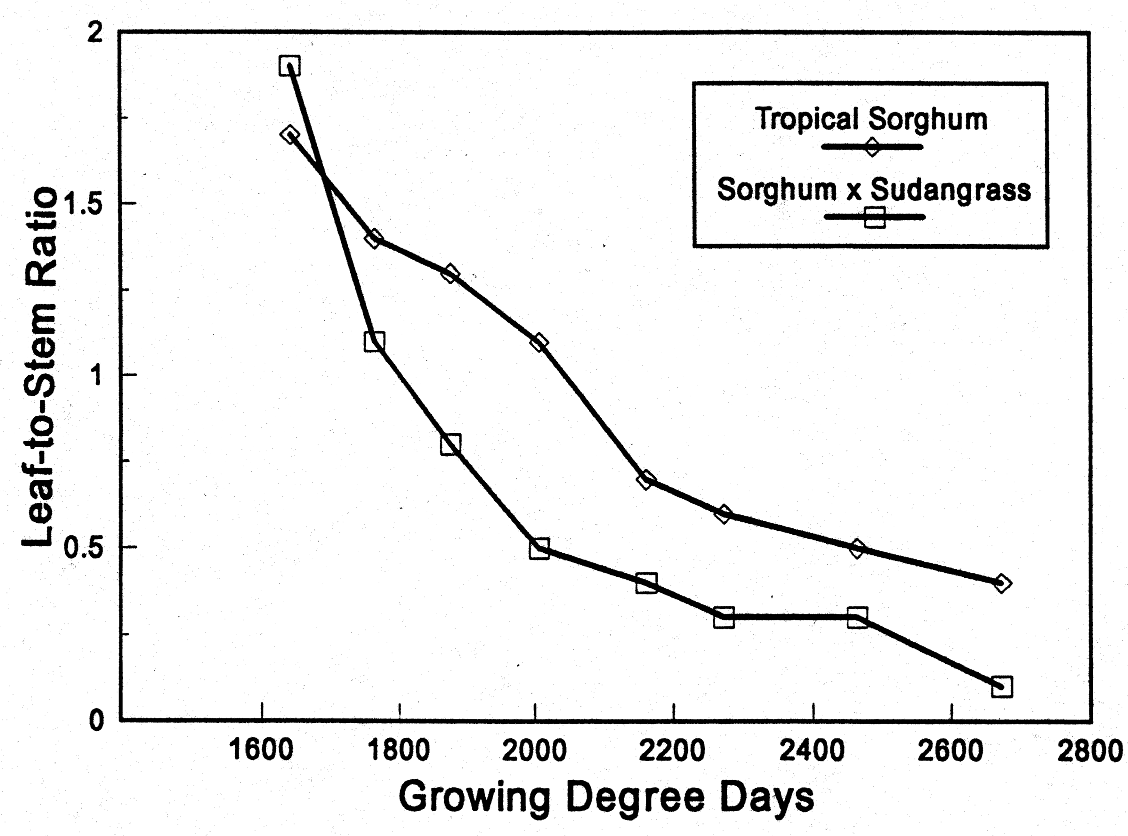

Fig. 2. Influence of growing degree days on leaf to stem ratio.

Plants were harvested at ground level 8 times during the growing season at approximately 7-day intervals and separated into leaf and stem components. Harvests were initiated 14 July and terminated 11 September. Mean stage by count (MSC) was determined for each harvest date using the system described by Moore et al. (1991). Leaf area per plant (in^2) was determined using the LICOR LI-3000 leaf area meter. Fractionated samples were dried in a forced-air oven at 131° F to a constant weight. Leaf-to-stem ratios and total dry matter per plant were determined following oven drying.

Results and Discussion

Mean stage by count and leaf area per plant for tropical sorghum and sorghum x sudangrass were very similar during the early summer, but diverged as growing degree days accumulated (Figs. 1 and 2). Sorghum x sudangrass floral initiation occurred when approximately 2200 growing degree days were accumulated. The MSC and leaf area per plant divergence in late summer was accentuated as sorghum x sudangrass floral development progressed. Floral initiation resulted in increased MSC due to increased seed maturation and reduced leaf area per plant due to senescence of lower leaf tissue. Tropical sorghum is photoperiod sensitive and did not initiate flowering in this environment. Tropical sorghum also produced fewer tillers than sorghum x sudangrass. The combination of these two factors

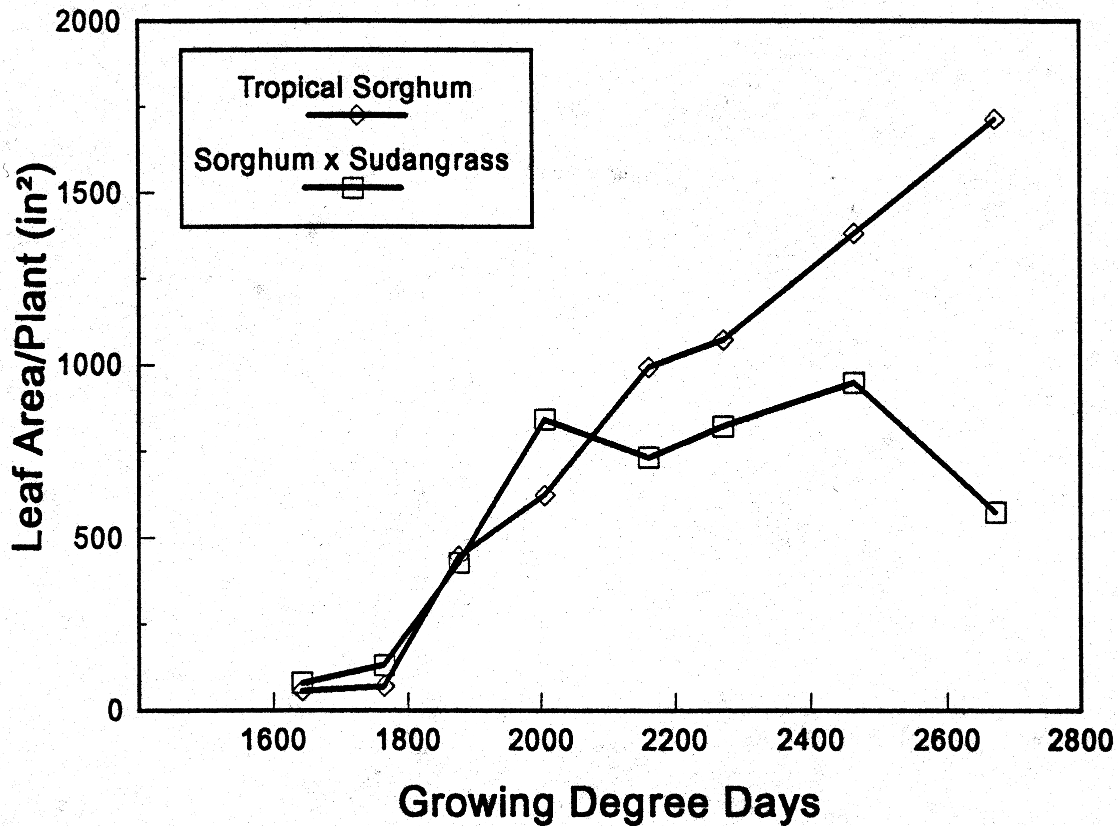

Fig. 3. Influence of growing degree days on leaf area per plant.

resulted in the distinct MSC differences between the two species. The leaf area per plant trends for sorghum x sudangrass follow trends similar to those reported by Bullock et al. (1991).

Leaf-to-stem ratios of tropical sorghum were usually greater than sorghum x sudangrass throughout the growing season (Fig. 3). This results primarily from the large leaves associated with tropical sorghum and the small leaves associated with sorghum x sudangrass. The increased tiller number and floral initiation of sorghum x sudangrass would increase nutrient assimilation to new tillers and seed production, therefore increasing senescence of lower leaves, reducing leaf to stem ratios.

atter per plant was greater for sorghum x sudangrass than tropical ughout the growing season, although end of season yield was very). The increased dry matter production of sorghum x sudangrass the increased tillering potential of sorghum x sudangrass. Sorghum x ically had 5 to 6 tillers per plant, while tropical sorghum usually had

Dry ma sorghum throu similar (Fig. 4 resulted from sudangrass typ 0 to 1.

Conclusions

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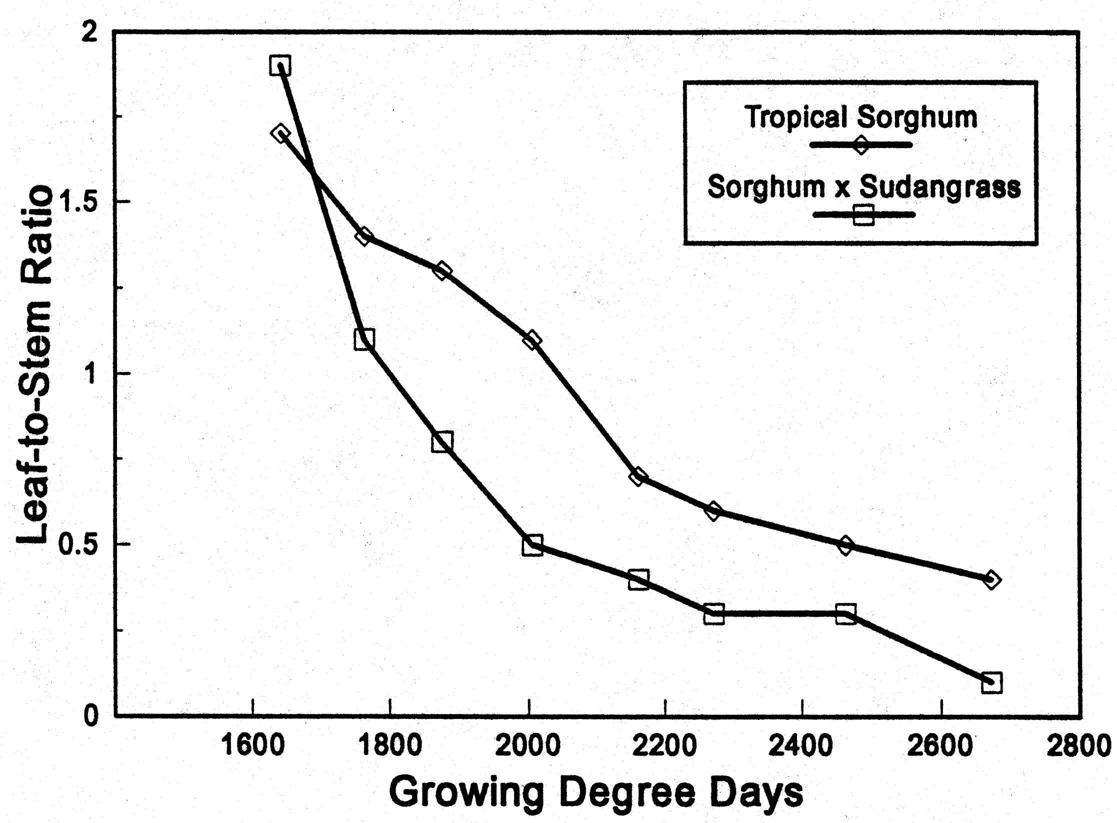

Fig. 4. Influence of growing degree days on dry matter per plant.

plant growth. This data will be used in subsequent research directed toward developing systems which optimize N removal from land treated with organic wastes.

Literature Cited

Bullock, D.G., M. Dugarte-Fernadez, J.L. Fowler, and K.J. Moore. 1991. Growth analysis of irrigated sorghum x sudangrass. Biotronics. 20:9-17.

Long, L.F. 1981. The influence of sorghum-sudangrass roots on nutrient leaching. Agron. J. 73:537-546.

Moore, K.J., L.E. Moser, K.P. Vogel, B.E. Johnson, and J.F. Pedersen. 1991. Describing and quantifying growth stages of perennial forage grasses. Agron. J. 83:1073-1077.

Myers, R.J.K. 1980. The root system of a grain sorghum crop. Field Crops Res. 3:53-64.

Pedersen, J.F., K.J. Moore, and S. Schroth. 1991. Nitrogen removal from a municipal sludge disposal site utilizing six groups of sorghum. Proc. Amer. Forage and Grassl. Conf. April 1-4. Columbia, Mo.